CLAIMS

What is claimed is

1. An error signal generating system, comprising:

(a) a coherent light beam;

(b) a tunable element positioned in said coherent light beam; and

(c) a detector positioned in said coherent light beam and configured to generate an error signal indicative of a characteristic associated with said tunable element in said coherent light beam.

2. The system of claim 1, further comprising a tuning assembly operatively coupled to said tunable element and said detector, said tuning assembly configured to tune said tunable element according to said error signal.

3. The error signal generating system of claim 2, wherein said characteristic associated with position of said tunable element with respect to said coherent light beam.

4. The error signal generating system of claim 2, wherein said tuning assembly is configured to positionally adjust said tunable element in said coherent light beam according to said error signal.

5. The error signal generating system of claim 1, wherein said tunable element defines a constructive interference fringe with respect to said coherent light beam, and said error signal is indicative of spatial losses associated with positioning of said constructive interference fringe within said coherent light beam.

6. The error signal generating system of claim 1, wherein said detector is a split detector.

7. An error signal generation system, comprising:

(a) a coherent light beam having a fixed wavelength;

(b) a tunable element positioned in an optical path defined by said coherent light beam;

(c) a detector positioned in said optical path and configured to generate an error signal indicative of a characteristic associated with said tunable element and said coherent light beam; and

(d) a tuning assembly operatively coupled to said tunable element and said detector, said tuning assembly configured to tune said tunable element according to said error signal.

8. The error signal generation and servo system of claim 7, wherein said tuning assembly is configured to translate said tunable element with respect to said optical path.

9. The error signal generation and servo system of claim 8, wherein said tunable element comprises a wedge etalon.

10. The system of claim 7, wherein said tunable element comprises an electro-optic substrate having a voltage controllable refractive index.

11. The system of claim 9, wherein said wedge etalon comprises a thin film device.

12. The system of claim 9, wherein said wedge etalon comprises an air gap etalon.

13. The system of claim 12, wherein said air gap etalon comprises a MEMS device having at least one movable reflective surface associated with said air gap etalon.

14. The system of claim 8, wherein said tunable element comprises a grating.

15. The error signal generating system of claim 7, wherein said detector is a split detector.

16. An error signal generation system, comprising:

(a) a coherent light beam having a fixed wavelength, said coherent light beam defining an optical path;

(b) a tunable element positioned in said optical path, said tunable element defining a constructive interference fringe with respect to said coherent light beam;

(c) a detector positioned in said optical path and configured to generate an error signal indicative of spatial losses to said coherent light beam associated with positioning of said constructive interference fringe in said optical path; and

(d) a tuning assembly operatively coupled to said tunable element and said detector, said tuning assembly configured to positionally adjust said constructive interference fringe according to said error signal.

17. The system of claim 16, wherein:

(a) said tunable element comprises an electro-optic material having a voltage controllable refractive index; and

(b) said tuning assembly comprises electrodes positioned in association with said electro-optic substrate and configured to deliver an effective voltage to said electrodes in response to said error signal.

18. The error signal generation and servo system of claim 7, wherein said tuning assembly is configured to move said tunable element with respect to said optical path.

19. The error signal generation and servo system of claim 18, wherein said tunable element comprises a wedge etalon.

20. The system of claim 18, wherein said wedge etalon comprises a thin film device.

21. The system of claim 18, wherein said wedge etalon comprises an air gap etalon.

22. The system of claim 21, wherein said air gap etalon comprises a MEMS device having at least one movable reflective surface associated with said air gap etalon.

23. The system of claim 18, wherein said tunable element comprises a grating.

24. The error signal generating system of claim 16, wherein said detector is a split detector.

25. A method for generating an error signal for an optical system, said method comprising:

(a) generating a beam of coherent light and directing said beam along an optical path;

(b) positioning a tunable element in said optical path;

(c) positioning a detector in said optical path after said tunable element; and

(d) generating an error signal from said detector indicative of a characteristic associated with said tunable element and said coherent light beam.

26. The method of claim 25, wherein said tunable element defines a constructive interference fringe with respect to said beam of coherent light, and said error signal is indicative of spatial losses to said coherent light beam associated with positioning of said constructive interference fringe in said optical path.

27. The method of claim 25, further comprising tuning said tunable element according to said error signal.

28. The method of claim 26, further comprising tuning said tunable element according to said error signal to position said constructive interference fringe in said optical path.

29. The method of claim 26, wherein said tunable element comprises a wedge etalon, and said tuning is carried out by positionally adjusting said wedge etalon with respect to said optical path.

30. The method of claim 26, wherein said tunable element comprises a grating, and said tuning is carried out by positionally adjusting said grating.

31. The method of claim 26, wherein said tunable element comprises an air gap etalon, and said tuning is carried out by adjusting a distance between reflective surfaces of said air gap etalon.

32. The method of claim 28, wherein said tunable element comprises an electro-optic substrate, and said tuning is carried out by adjusting a voltage applied to said electro-optic substrate.

33. The method of claim 26, wherein said detector is a split detector, and said generating said error signal comprises generating a difference signal associated with output from different portions of said split detector.

34. A method for generating an error signal for an optical system, said method comprising:

(a) generating a beam of coherent light and directing said beam along an optical path;

(b) positioning a tunable element in said optical path, said tunable element defining a constructive interference fringe with respect to said beam of coherent light;

(c) positioning a detector in said optical path after said tunable element; and

(d) generating an error signal from said detector that is indicative of a position of said constructive interference fringe in said optical path.

35. The method of claim 34, further comprising tuning said tunable element according to said error signal to position said constructive interference fringe with respect to said coherent light beam.

36. The method of claim 35, wherein said tunable element comprises a wedge etalon, and said tuning is carried out by positionally adjusting said wedge etalon with respect to said optical path.

37. The method of claim 35, wherein said tunable element comprises a grating, and said tuning is carried out by positionally adjusting said grating.

38. The method of claim 35, wherein said tunable element comprises an air gap etalon, and said tuning is carried out by adjusting a distance between reflective surfaces of said air gap etalon.

39. The method of claim 35, wherein said tunable element comprises an electro-optic substrate, and said tuning is carried out by adjusting a voltage applied to said electro-optic substrate.

40. The method of claim 34, wherein said detector is a split detector, and said generating said error signal comprises generating a difference signal associated with output from different portions of said split detector.

41. An external cavity laser system, comprising:

(a) a tunable element positioned in an optical path defined by a coherent light beam, said tunable element defining a constructive interference fringe with respect to said coherent light beam;

(b) a detector positioned in said optical path after said tunable element; and

(c) a tuning assembly operatively coupled to said detector and configured to tune said tunable element and positionally adjust said constructive interference fringe in said optical path according to an error signal from said split detector.

42. The external cavity laser system of claim 41, wherein said tunable element is positioned within an external cavity laser in said optical path, and said detector positioned outside said external cavity laser in said optical path after said tunable element.

43. The external cavity laser system of claim 42, further comprising an end mirror and a gain medium having a reflective rear facet, said end mirror and said reflective rear facet defining said external cavity, said gain medium emitting said coherent beam along said optical path.

44. The external cavity laser system of claim 27, further comprising a grid generator, said grid generator positioned in said optical path.

45. The external cavity laser system of claim 44, wherein said grid generator comprises a grid etalon positioned within said external cavity in said optical path between said gain medium and said end mirror, said tunable element positioned in said optical path between said gain medium and said end mirror.

46. The external cavity laser system of claim 41, wherein said tuning assembly further comprises a drive element, said drive element operatively coupled to said tunable element and said detector, said drive element configured to tune said tunable element according to said error signal.

47. The external cavity laser system of claim 41, wherein said tuning assembly further comprises a difference signal generator operatively coupled to said drive element and said detector, said difference signal generator configured to generate said error signal according to output from said split detector.

48. The external cavity laser system of claim 41, wherein said detector is a split detector.

49. An external cavity laser system, comprising:

(a) a detector positioned in an optical path defined by a coherent light beam associated with said external cavity laser; and

(b) a first tuning assembly operatively coupled to said detector and configured to tune a tunable element positioned in said optical path according to a first error signal from said detector.

50. The external cavity laser system of claim 49, further comprising a second tuning assembly operatively coupled to said split detector and configured to positionally tune an end mirror of said external cavity laser according to a second error signal from said detector.

51. The external cavity laser system of claim 35, further comprising a drive current controller operatively coupled to a gain medium, said gain medium emitting said coherent beam of light, said drive current controller configured to adjust drive current delivered to said gain medium according to a third error signal.

52. The external cavity laser system of claim 51, wherein said third error signal is derived from said detector.

53. The external cavity laser system of claim 51, wherein said gain medium includes a rear facet, said rear facet and said end mirror defining an external cavity, said tunable element positioned in said optical path between said gain medium and said end mirror.

54. The external cavity laser system of claim 53, wherein said external cavity laser further comprises a grid generator, said grid generator positioned in said optical path between said gain medium and said end mirror.

55. The external cavity laser system of claim 49, wherein said first tuning assembly comprises a drive element operatively coupled to said tunable element and said split detector, said drive element configured to move said tunable element according to said first error signal.

56. The external cavity laser system of claim 55, wherein said first tuning assembly further comprises a difference signal generator operatively coupled to said drive element and said split detector, said first error signal generated by said difference signal generator.

57. The external cavity laser system of claim 50, wherein said second tuning assembly comprises a drive element operatively coupled to said split detector and said end mirror, said drive element configured to translate said end mirror according to said second error signal.

58. The external cavity laser system of claim 57, wherein said second tuning assembly further comprises a sum signal generator operatively coupled to said drive element and said split detector, said second error signal generated by said sum signal generator.

59. The external cavity laser system of claim 58, wherein said second tuning assembly further comprises an oscillator element associated with said drive element.

60. The external cavity laser system of claim 49, wherein said detector is a split detector.